Claims

We Claim:

1 A wavelength-selective optical transmission system comprising:

a first waveguide for transmitting a multiplexed optical signal therethrough;

a second waveguide coupled to said first waveguide wherein a least one of said first and second waveguides having a set of wavelength-selective Bragg gratings disposed near a coupling section between said first and second waveguides to reflect a reflecting optical signal back to said first waveguide and for transmitting a contra-directional optical signal and a co-directional optical signal having respectively a contra-directional selected wavelength and a co-directional selected wavelength corresponding to said Bragg gratings wherein one of said contra-directional and co-directional wavelengths is chosen as a designated wavelength, and said reflecting optical signal and one of said contra-directional or co-directional optical signals are outside of a predefined range surrounding said designated wavelength.

2 The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide and said second waveguide have two different propagation constants.

3 The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide and said second waveguide composing of two different materials.

4. The wavelength-selective optical transmission system of claim 1 wherein:

said Bragg gratings disposed on said first waveguide.

5. The wavelength-selective optical transmission system of claim 1 wherein:

said Bragg gratings disposed on said second waveguide.

6. The wavelength-selective optical transmission system of claim 1 wherein:

said Bragg gratings disposed on said first and second waveguides.

7. The wavelength-selective optical transmission system of claim 1 wherein:

said Bragg gratings disposed on a cladding surrounding said first waveguide.

8. The wavelength-selective optical transmission system of claim 1 wherein:

said Bragg gratings disposed on a cladding surrounding said second waveguide.

9. The wavelength-selective optical transmission system of claim 1 wherein:

said Bragg gratings disposed on a cladding in a gap between said first and second waveguides.

10. The wavelength-selective optical transmission system of claim 1 wherein:

said Bragg gratings comprising a periodic variation of a refractive index of an optical propagation material.

11. The wavelength-selective optical transmission system of claim 1 wherein:

said Bragg gratings comprising a periodic variation of a structural characteristic of an optical propagation material.

12. The wavelength-selective optical transmission system of claim 1 wherein:

said Bragg gratings comprising a periodic variation of a structural characteristic and a refractive index of an optical propagation material.

13. The wavelength-selective optical transmission system of claim 1 wherein:

at least one of said first and second waveguides are manufactured on a substrate by applying an integrated circuit (IC) manufacturing process thereon.

14. The wavelength-selective optical transmission system of claim 1 wherein:

said predefined range of wavelength surrounding said designated selected wavelength having a wavelength range between λmin and λmax and said first and second waveguide having an optical propagation constant of β_1 and β_2 respectively.

15. The wavelength-selective optical transmission system of claim 14 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\beta_1 < \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \max\left(\frac{2\beta_1}{\beta_1+\beta_2}, \frac{\beta_2-\beta_1}{\beta_1+\beta_2}\right)$.

16. The wavelength-selective optical transmission system of claim 14 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\beta_1 > \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \max\left(\frac{\beta_1+\beta_2}{2\beta_1}, \frac{\beta_1-\beta_2}{\beta_1+\beta_2}\right)$.

17. The wavelength-selective optical transmission system of claim 14 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\beta_1 < \beta_2$ and

$$\frac{\lambda_{min}}{\lambda_{max}} > \min\left[\max\left(\frac{2\beta_1}{\beta_2-\beta_1}, \frac{\beta_2-\beta_1}{\beta_2+\beta_1}\right), \frac{\beta_2-\beta_1}{2\beta_1}\right].$$

18. The wavelength-selective optical transmission system of claim 14 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\beta_1 > \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_1 - \beta_2}{\beta_1 + \beta_2}$.

19. The wavelength-selective optical transmission system of claim 14 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\beta_2 > 3\beta_1$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_2 - \beta_1}{\beta_1 + \beta_2}$.

20. The wavelength-selective optical transmission system of claim 14 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\beta_1 < \beta_2 < 3\beta_1$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{2\beta_1}{\beta_1 + \beta_2}$.

21. The wavelength-selective optical transmission system of claim 14 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\left(\sqrt{5} - 2\right)\beta_1 < \beta_2 < \beta_1$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_1 + \beta_2}{2\beta_1}$.

22. The wavelength-selective optical transmission system of claim 14 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\beta_2 < \left(\sqrt{5} - 2\right)\beta_1$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_2 - \beta_1}{\beta_2 + \beta_1}$.

23. The wavelength-selective optical transmission system of claim 14 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\left(\sqrt{5} - 2\right)\beta_2 < \beta_1 < \frac{\beta_2}{3}$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{2\beta_1}{\beta_2 - \beta_1}$.

24. The wavelength-selective optical transmission system of claim 14 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\beta_1 < \left(\sqrt{5} - 2\right)\beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_2 - \beta_1}{\beta_2 + \beta_1}$.

25. The wavelength-selective optical transmission system of claim 14 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\frac{\beta_2}{3} < \beta_1 < \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_2 - \beta_1}{2\beta_1}$.

26. The wavelength-selective optical transmission system of claim 14 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\beta_1 > \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_1 - \beta_2}{\beta_1 + \beta_2}$.

27. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a SiO2 cladding and a doped SiO2 core and said second waveguide have a SiO2 cladding and a SiRN core.

28. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a SiO2 cladding and a doped SiO2 core and said second waveguide have a SiO2 cladding and a Si core.

29. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a SiO2 cladding and a doped SiO2 core and said second waveguide have a SiO2 cladding and a SiO_xN_y core.

30. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a SiO2 cladding and a doped SiO2 core and said second waveguide have a SiO2 cladding and a Si_3N_4 core.

31. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a SiO2 cladding and a doped SiO2 core and said second waveguide have a SiO2 cladding and a Ta_2O_5 & SiO_2 core.

32. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a SiO2 cladding and a doped SiO_xN_y core and said second waveguide have a SiO2 cladding and a SiRN core.

33. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a SiO2 cladding and a doped SiO_xN_y core and said second waveguide have a SiO2 cladding and a Si core.

34. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a SiO2 cladding and a doped SiO_xN_y core and said second waveguide have a SiO2 cladding and a SiO_xN_y core.

35. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a SiO2 cladding and a doped SiO_xN_y core and said second waveguide have a SiO2 cladding and a Ta_2O_5 & SiO_2 core.

36. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a first doped SiO_2 cladding and a doped SiO_2 core of different dopant concentration than said first doped SiO_2 cladding and said second waveguide have a second doped SiO_2 cladding and a SiRN core.

37. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a first doped SiO_2 cladding and a doped SiO_2 core of different dopant concentration than said first doped SiO_2 cladding and said second waveguide have a second doped SiO_2 cladding and a Si core.

38. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a first doped SiO_2 cladding and a doped SiO_2 core of different dopant concentration than said first doped SiO_2 cladding and said second waveguide have a second doped SiO_2 cladding and a SiO_xN_y core.

39. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a first doped SiO_2 cladding and a doped SiO_2 core of different dopant concentration than said first doped SiO_2 cladding and said second waveguide have a second doped SiO_2 cladding and a Si_3N_4 core.

40. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a first doped SiO_2 cladding and a doped SiO_2 core of different dopant concentration than said first doped SiO_2 cladding and said second waveguide have a second doped SiO_2 cladding and a Ta_2O_5 & SiO_2 core.

41. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a first doped SiO_2 cladding and a SiO_xN_y core and said second waveguide have a second doped SiO_2 cladding and a SiRN core.

42. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a first doped SiO_2 cladding and a SiO_xN_y core and said second waveguide have a second doped SiO_2 cladding and a Si core.

43. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a first doped SiO_2 cladding and a SiO_xN_y core and said second waveguide have a second doped SiO_2 cladding and a SiO_xN_y core.

44. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a first doped SiO_2 cladding and a SiO_xN_y core and said second waveguide have a second doped SiO_2 cladding and a Si_3N_4 core.

45. The wavelength-selective optical transmission system of claim 1 wherein:

said first waveguide having a first doped SiO_2 cladding and a SiO_xN_y core and said second waveguide have a second doped SiO_2 cladding and a Ta_2O_5 & SiO_2 core.

46. A wavelength-selective optical transmission system comprising:

a first waveguide for transmitting a multiplexed optical signal therethrough;

a second waveguide coupled to said first waveguide wherein at least one of said first and second waveguides having a set of wavelength-selective Bragg gratings disposed near a coupling section between said first and second waveguides wherein said first and second waveguides having different propagation constants.

47. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a SiO2 cladding and a doped SiO2 core and said second waveguide have a SiO2 cladding and a SiRN core.

48. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a SiO2 cladding and a doped SiO2 core and said second waveguide have a SiO2 cladding and a Si core.

49. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a SiO2 cladding and a doped SiO2 core and said second waveguide have a SiO2 cladding and a SiO_xN_y core.

50. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a SiO2 cladding and a doped SiO2 core and said second waveguide have a SiO2 cladding and a Si_3N_4 core.

51. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a SiO2 cladding and a doped SiO2 core and said second waveguide have a SiO2 cladding and a Ta_2O_5 & SiO_2 core.

52. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a SiO2 cladding and a doped SiO_xN_y core and said second waveguide have a SiO2 cladding and a SiRN core.

53. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a SiO2 cladding and a doped SiO_xN_y core and said second waveguide have a SiO2 cladding and a Si core.

54. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a SiO2 cladding and a doped SiO_xN_y core and said second waveguide have a SiO2 cladding and a SiO_xN_y core.

55. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a SiO2 cladding and a doped SiO_xN_y core and said second waveguide have a SiO2 cladding and a Ta_2O_5 & SiO_2 core.

56. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a first doped SiO_2 cladding and a doped SiO_2 core of different dopant concentration than said first doped SiO_2 cladding and said second waveguide have a second doped SiO_2 cladding and a SiRN core.

57. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a first doped SiO_2 cladding and a doped SiO_2 core of different dopant concentration than said first doped SiO_2 cladding and said second waveguide have a second doped SiO_2 cladding and a Si core.

58. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a first doped SiO_2 cladding and a doped SiO_2 core of different dopant concentration than said first doped SiO_2 cladding and said second waveguide have a second doped SiO_2 cladding and a SiO_xN_y core.

59. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a first doped SiO_2 cladding and a doped SiO_2 core of different dopant concentration than said first doped SiO_2 cladding and said second waveguide have a second doped SiO_2 cladding and a Si_3N_4 core.

60. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a first doped SiO_2 cladding and a doped SiO_2 core of different dopant concentration than said first doped SiO_2 cladding and said second waveguide have a second doped SiO_2 cladding and a Ta_2O_5 & SiO_2 core.

61. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a first doped SiO_2 cladding and a SiO_xN_y core and said second waveguide have a second doped SiO_2 cladding and a SiRN core.

62. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a first doped SiO_2 cladding and a SiO_xN_y core and said second waveguide have a second doped SiO_2 cladding and a Si core.

63. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a first doped SiO_2 cladding and a SiO_xN_y core and said second waveguide have a second doped SiO_2 cladding and a SiO_xN_y core.

64. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a first doped SiO_2 cladding and a SiO_xN_y core and said second waveguide have a second doped SiO_2 cladding and a Si_3N_4 core.

65. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide having a first doped SiO_2 cladding and a SiO_xN_y core and said second waveguide have a second doped SiO_2 cladding and a Ta_2O_5 & SiO_2 core.

66. The wavelength-selective optical transmission system of claim 46 wherein:

said Bragg gratings reflecting an optical signal back to said first waveguide and transmitting a contra-directional optical signal and a co-directional optical signal having respectively a contra-directional selected wavelength and a co-directional selected wavelength corresponding to said Bragg gratings wherein one of said contra-directional and co-directional wavelengths is chosen as a designated wavelength, and said reflecting optical signal and one of said contra-directional or co-directional optical signals are outside of a predefined range surrounding said designated wavelength.

67. The wavelength-selective optical transmission system of claim 46 wherein:

said first waveguide and said second waveguide are composed of two different materials.

68. The wavelength-selective optical transmission system of claim 46 wherein:

said Bragg gratings disposed on said first waveguide.

69. The wavelength-selective optical transmission system of claim 46 wherein:

said Bragg gratings disposed on said second waveguide.

70. The wavelength-selective optical transmission system of claim 46 wherein:

said Bragg gratings disposed on said first and second waveguides.

71. The wavelength-selective optical transmission system of claim 46 wherein:

said Bragg gratings disposed on a cladding surrounding said first waveguide.

72. The wavelength-selective optical transmission system of claim 46 wherein:

said Bragg gratings disposed on a cladding surrounding said second waveguide.

73. The wavelength-selective optical transmission system of claim 46 wherein:

said Bragg gratings disposed on a cladding in the gap between said first and second waveguides.

74. The wavelength-selective optical transmission system of claim 66 wherein:

said predefined range of wavelength surrounding said designated selected wavelength having a wavelength range between λmin and λmax and said first and second waveguide having an optical propagation constant of β_1 and β_2 respectively.

75. The wavelength-selective optical transmission system of claim 74 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\beta_1 < \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \max\left(\frac{2\beta_1}{\beta_1+\beta_2}, \frac{\beta_2-\beta_1}{\beta_1+\beta_2}\right)$.

76. The wavelength-selective optical transmission system of claim 74 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\beta_1 > \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \max\left(\frac{\beta_1+\beta_2}{2\beta_1}, \frac{\beta_1-\beta_2}{\beta_1+\beta_2}\right)$.

77. The wavelength-selective optical transmission system of claim 74 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\beta_1 < \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \min\left[\max\left(\frac{2\beta_1}{\beta_2-\beta_1}, \frac{\beta_2-\beta_1}{\beta_2+\beta_1}\right), \frac{\beta_2-\beta_1}{2\beta_1}\right]$.

78. The wavelength-selective optical transmission system of claim 74 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\beta_1 > \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_1-\beta_2}{\beta_1+\beta_2}$.

79. The wavelength-selective optical transmission system of claim 74 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\beta_2 > 3\beta_1$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_2-\beta_1}{\beta_1+\beta_2}$.

80. The wavelength-selective optical transmission system of claim 74 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\beta_1 < \beta_2 < 3\beta_1$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{2\beta_1}{\beta_1 + \beta_2}$.

81. The wavelength-selective optical transmission system of claim 74 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\left(\sqrt{5} - 2\right)\beta_1 < \beta_2 < \beta_1$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_1 + \beta_2}{2\beta_1}$.

82. The wavelength-selective optical transmission system of claim 74 wherein:

said contra-directional wavelength is chosen as said designated wavelength and $\beta_2 < \left(\sqrt{5} - 2\right)\beta_1$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_2 - \beta_1}{\beta_2 + \beta_1}$.

83. The wavelength-selective optical transmission system of claim 74 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\left(\sqrt{5} - 2\right) \beta_2 < \beta_1 < \frac{\beta_2}{3}$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{2\beta_1}{\beta_2 - \beta_1}$.

84. The wavelength-selective optical transmission system of claim 74 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\beta_1 < \left(\sqrt{5} - 2\right)\beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_2 - \beta_1}{\beta_2 + \beta_1}$.

85. The wavelength-selective optical transmission system of claim 74 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\frac{\beta_2}{3} < \beta_1 < \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_2 - \beta_1}{2\beta_1}$.

86. The wavelength-selective optical transmission system of claim 74 wherein:

said co-directional wavelength is chosen as said designated wavelength and $\beta_1 > \beta_2$ and $\frac{\lambda_{min}}{\lambda_{max}} > \frac{\beta_1 - \beta_2}{\beta_1 + \beta_2}$.

87. The wavelength-selective optical transmission system of claim 46 wherein:

said Bragg gratings comprising a periodic variation of a refractive index of an optical propagation material.

88. The wavelength-selective optical transmission system of claim 46 wherein:

said Bragg gratings comprising a periodic variation of a structural characteristic of an optical propagation material.

89. The wavelength-selective optical transmission system of claim 46 wherein:

said Bragg gratings comprising a periodic variation of a structural characteristic and a refractive index of an optical propagation material.

90. The wavelength-selective optical transmission system of claim 46 wherein:

at least one of said first and second waveguides are manufactured on a substrate by applying an integrated circuit (IC) manufacturing process thereon.

91. A wavelength-selective optical transmission system comprising:

a first and a second waveguides;

said second waveguide disposed on a vertically stacked position on said first waveguide and at least one of said first and second waveguides having a set of wavelength-selective Bragg gratings disposed near a coupling section between said first and second waveguides wherein said first and second waveguides having different optical propagation constants.

92. The wavelength-selective optical transmission system of claim 91 wherein:

said Bragg gratings comprising a periodic variation of a refractive index of an optical propagation material.

93. The wavelength-selective optical transmission system of claim 91 wherein:

said Bragg gratings comprising a periodic variation of a structural characteristic of an optical propagation material.

94. The wavelength-selective optical transmission system of claim 91 wherein:

said Bragg gratings comprising a periodic variation of a structural characteristic and a refractive index of an optical propagation material.

95. The wavelength-selective optical transmission system of claim 91 wherein:

at least one of said first and second waveguides are manufactured on a substrate by applying an integrated circuit (IC) manufacturing process thereon.

96. The wavelength-selective optical transmission system of claim 91 wherein:

said Bragg gratings disposed on said first waveguide.

97. The wavelength-selective optical transmission system of claim 91 wherein:

said Bragg gratings disposed on said second waveguide.

98. The wavelength-selective optical transmission system of claim 91 wherein:

said Bragg gratings disposed on said first and second waveguides.

99. The wavelength-selective optical transmission system of claim 91 wherein:

said Bragg gratings disposed on a cladding surrounding said first waveguide.

100. The wavelength-selective optical transmission system of claim 91 wherein:

said Bragg gratings disposed on a cladding surrounding said second waveguide.

101. The wavelength-selective optical transmission system of claim 91 wherein:

said Bragg gratings disposed on a cladding in a gap between said first and second waveguides.